

# The Changing Landscape of Chemical Toxicity Values and Challenges Presented with Trichloroethylene

**Anita K. Meyer DABT**

Environmental & Munitions CX

Huntsville Engineering  
and Support Center

**SRA Annual Meeting**

San Francisco, CA

December 11, 2012



®



<b>Report Documentation Page</b>			<i>Form Approved OMB No. 0704-0188</i>			
<p>Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.</p>						
1. REPORT DATE <b>11 DEC 2012</b>		2. REPORT TYPE		3. DATES COVERED <b>00-00-2012 to 00-00-2012</b>		
<p>4. TITLE AND SUBTITLE <b>The Changing Landscape of Chemical Toxicity Values and Challenges Presented with Trichloroethylene</b></p>						
					5a. CONTRACT NUMBER	
					5b. GRANT NUMBER	
<p>5c. PROGRAM ELEMENT NUMBER</p>						
<p>6. AUTHOR(S)</p>						
					5d. PROJECT NUMBER	
					5e. TASK NUMBER	
5f. WORK UNIT NUMBER						
<p>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Environmental &amp; Munitions CX, Huntsville Engineering, and Support Center, Huntsville, AL, 35807</b></p>						
<p>8. PERFORMING ORGANIZATION REPORT NUMBER</p>						
<p>9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)</p>						
					10. SPONSOR/MONITOR'S ACRONYM(S)	
<p>11. SPONSOR/MONITOR'S REPORT NUMBER(S)</p>						
<p>12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b></p>						
<p>13. SUPPLEMENTARY NOTES <b>Presented at the Society for Risk Analysis Annual Meeting, San Francisco, CA, December 9-12, 2012</b></p>						
<p>14. ABSTRACT</p>						
<p>15. SUBJECT TERMS</p>						
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES		
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>	<b>Same as Report (SAR)</b>	<b>18</b>		
<b>19a. NAME OF RESPONSIBLE PERSON</b>						

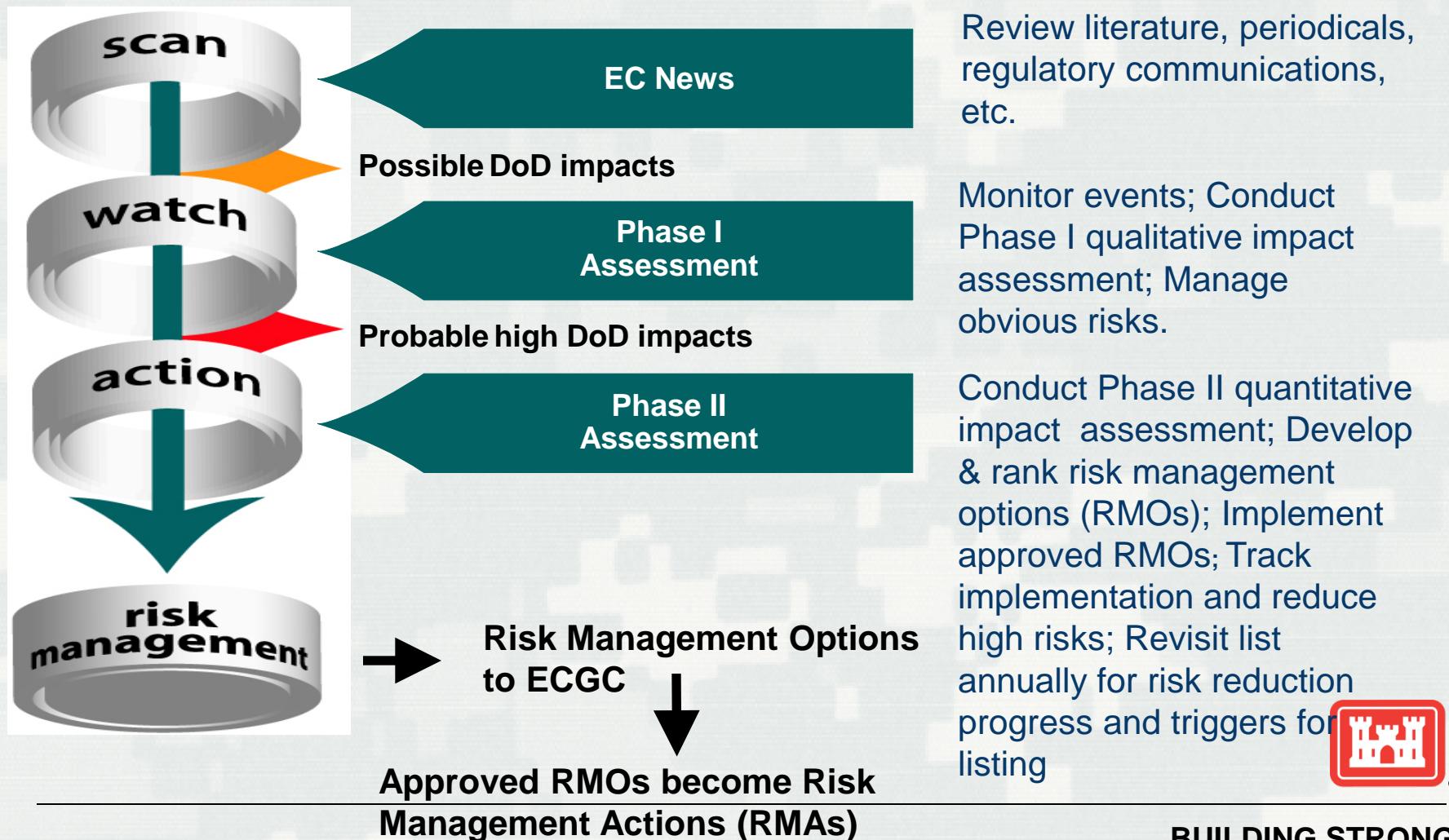
# Emerging Contaminants (ECs)

- Are chemicals or materials of interest that are characterized by:
  - ▶ a perceived or real threat to human health or environment, and
  - ▶ there is no currently published health standard or there is an existing health standard, but *the standard is evolving or being re-evaluated.*

Source: “Initiation of Emerging Contaminants Characterization and Response Actions for Protection of Human Health” Issue Paper (ECOS & DoD Sustainability Workgroup, 2008)



# DoD's Scan, Watch, Action Process: Identifying, Prioritizing & Pursuing Risk Management



# IRIS Documents Reviewed by DoD Services

- Benzo(a)pyrene
- Trimethylbenzenes
- Dioxin



# Other Chemicals of DoD Interest Undergoing IRIS Reassessment

- 1,4-Dioxane
- Dioxin (cancer)
- RDX
- Arsenic
- Phthalates (multiple)
- Vanadium pentoxide
- Relative potency factors for PAHs
- Hexavalent chromium



# Trends Observed During Review of IRIS Documents

- Candidate RfDs and RfCs
- Biological based models reducing uncertainty factors
- Identification of developmental endpoints
- Some recommendations from NAS formaldehyde panel are being incorporated
  - ▶ Preamble describes process
  - ▶ Evidence tables
  - ▶ Manageable length



# Trichloroethylene Case Study

- IRIS Toxicological Review published September 2011
- Chronic oral RfD of 0.0005 mg/kg/day, a chronic inhalation RfC of 0.002 mg/m<sup>3</sup>; classified as "carcinogenic to humans" with an oral slope factor of  $4.6 \times 10^{-2}$  per mg/kg/day and an inhalation unit risk of  $4.1 \times 10^{-6}$  per  $\mu\text{g}/\text{m}^3$



# Inhalation Unit Risk and Oral Slope Factor

- Non-Hodgkins lymphoma
- Liver cancer
- Kidney cancer
  - ▶ Mutagenic mode of action
  - ▶ Apply age dependent adjustment factors to kidney only
- Oral values route extrapolated from inhalation unit risk



# Reference Dose and Reference Concentration

- Decreased thymus weight in mice
- Developmental immunotoxicity
- Fetal cardiac malformations

RfC:

- Decreased thymus weight in mice
- Fetal cardiac malformations
- Route extrapolated from drinking water studies



# Risk-based Screening Levels for TCE

- Under CERCLA acceptable risks are between 1E-04 and 1E-06
- 1E-06 is point of departure for remediation goals once determined an action is necessary

Risk-Based Screening Levels*		
	Res. Water ( $\mu\text{g}/\text{L}$ )	Air ( $\mu\text{g}/\text{m}^3$ )
Non-Cancer Hazard of 1	2.6	2.1
$10^{-6}$ Cancer Risk	0.43	0.44

Industrial/Commercial 8.8  $\mu\text{g}/\text{m}^3$  vs. OSHA 535  $\text{mg}/\text{m}^3$



\* EPA Regional Screening Levels (residential)

# Challenges presented by IUR and OSF

- Multi step process to which yields no major difference for risk managers

0.59 vs 0.44  $\mu\text{g}/\text{m}^3$

- Low air screening level of 0.44  $\mu\text{g}/\text{m}^3$  is below common background value of 1  $\mu\text{g}/\text{m}^3$  TCE

1. Run the RSL [calculator](#) with the mutagenic option switched on to incorporate the ADAF (Age-Dependent Adjustment Factor) and estimate a TCE concentration based on kidney mutagenic endpoint (IUR of  $1\text{E-}06 (\mu\text{g}/\text{m}^3)^{-1}$  and oral slope factor of  $9.3\text{E-}03 (\text{mg}/\text{kg}\cdot\text{day})^{-1}$ ). The first page of the calculator should look like [this](#) if calculating residential soil, air and tapwater RSLs. Then, make the following changes to the [toxicity values](#) and the [properties](#) (VOC?, Mutagen? and EPD?). The [soil](#), [air](#) and [tapwater](#) results are then displayed for the mutagenic RSLs.
2. Run the RSL [calculator](#) with the mutagenic option switched off and estimate a TCE concentration based on non-kidney (NHL/liver) cancer endpoint (IUR of  $3.1\text{E-}06 (\mu\text{g}/\text{m}^3)^{-1}$  and oral slope factor of  $3.7\text{E-}02 (\text{mg}/\text{kg}\cdot\text{day})^{-1}$ ). The first page of the calculator should look like [this](#) if calculating residential soil, air and tapwater RSLs. Then, make the following changes to the [toxicity values](#) and the [properties](#) (VOC?, Mutagen? and EPD?). The [soil](#), [air](#) and [tapwater](#) results are then displayed for the mutagenic RSLs.
3. For each environmental media, take the reciprocal of the two resulting TCE RSL concentrations, and add them together ( $1/\text{conc\_mutagen} + 1/\text{conc\_cancer}$ ) before inverting back to a final RSL concentration. ( $1/(1/\text{conc\_mutagen} + 1/\text{conc\_cancer})$ ). The detailed equations for resident [soil](#), [air](#) and [tapwater](#) are presented.



# Case Study: TCE Vapor Intrusion Project

- TCE used between 1960s and 1980s
  - ▶ Underground storage tanks and piping
  - ▶ Secondary loop of coolant for ice pool inside one building
  - ▶ Underground refrigerant
- Confirmed vapor intrusion into buildings; investigation and mitigation is ongoing
- Site specific action levels exceeded – child-care and industrial values



# Case Study: TCE Vapor Intrusion Project

Various management options pursued

- HVAC system
- Sub slab depressurization
- Air purifiers
- Office relocation

Some samples of outdoor air exceed residential screening level



# Challenges Presented by Noncancer Values

- The chronic RfC is protective of long-term exposures to sensitive subpopulations
  - ▶ But what about critical exposure period?
- Vapor intrusion is highly variable
  - ▶ Seasonally influenced by heating/cooling; groundwater table
  - ▶ Daily influences, wind, doors opening/closing
- How should excursions above action level be monitored and managed?



# Management/Communication Challenges

- Who's OK and who is not?
  - ▶ Privacy concerns regarding requests for relocation
- Credibility – how long do we wait for an answer from HQEPA?
- Management of real time data and variability— when do we take action?  
Readings may be high one hour and not the next.



# Monitoring Strategies



# Remaining Questions and Issues

- Differing interpretations by EPA Regions and States
- Does a chronic RfC represent a critical exposure window of ~ 2 weeks?
- RAGS Pt F: Exposure duration evaluated should be consistent with exposure duration represented by the toxicity value
- Why not publish developmental RfC/RfDs per the *EPA Guidelines for Developmental Toxicity Risk Assessment?*

